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Science and Art Gossip.

A singular idea seems to prevail in the minds of many respecting the position of men of science in the matter of religion. They seem to imagine that most men of science are enemies of religion, or at the best are wanting in religion. My experience—which has made me acquainted with great numbers of men of science, science teachers, and science students—points quite the opposite way. I should say that in the best and only true sense of the word the followers of science are, on the average, more religious than those who do not study science. And this is only natural. The investigations of science set the unknown which lies at the back of the known and of the knowable behind the veil of an infinite mystery. The comparatively commonplace ideas of those who have not learned to recognise the vastness of the universe, and the infinite time intervals belonging to its history, must give place in the mind of the student of nature to worthier though less tangible conceptions.

But again, it seems imagined by many that the man of science, "to suit his private ends," wishes to dispossess men's minds of religious ideas. Men seem continually on the watch for sneers and scoffs where neither sneer nor scoff is intended—nay, where it has been the object of the student of science to relieve religion from the oppression of low or degrading conceptions. Men who are not students of nature can hardly conceive with what pain the man of science sometimes notes their singularly narrow and stunted ideas of religion. Yet when he rejects ideas which seem to him almost as insults to the sacred name of religion, they exclaim—and doubtless they really believe—that he is a scoffer and a sneerer.

The student of science has the same interest that all men have, and ever must have, in religion, both as it affects himself, and as it affects his neighbour and the world at large. His studies in one department of science show him—what some who speak more loudly on the subject have not as thoroughly noted—the value and importance of religion to the world. He knows better than they can tell him the folly of scoffing or sneering at religion. But he sees also that it is a duty all men owe to religion to remove it from all association with what is selfish, or profane, or less pure and perfect than it might be.

Men, however, who chance not to be students of science, call those who are (or, perhaps, are teachers of science), unbelievers and misbelievers, just as the Paynims of old called the Crusaders, whose religion was unfamiliar to them, infidel dogs and sons of the evil one.

We are led to "anticipate that the diverse forms of religious belief which have existed, and which still exist, have all a basis in some ultimate fact. Judging by analogy, the implication is, not that any one of them is altogether right, but that in each there is something right, more or less disguised by other things wrong. It may be that the soul of truth contained in erroneous creeds is very unlike most, if not all, of its several embodiments; and indeed, if, as we have good reason to expect, it is much more abstract than any of them, its unlikeness necessarily follows. But however different from its concrete expressions, some essential verity must be looked for. To suppose that these multiform conceptions should be one and all *absolutely* groundless, discredits too profoundly that average human intelligence from which all our individual intelligences are derived."—Herbert Spencer, "First Principles," Vol. I., Part I., chap. i., sect. 4.

Two correspondents send us information respecting the place at Edinburgh where the resolution quoted at page 156, col. 2, was passed. We have nothing to do with this. The resolution alone concerned us; and that was quoted from the *Times* and other leading papers. If the resolution had been passed in Bedlam it would none the less have been sound and just in itself. We are glad to see that a Church of England Society has taken precisely the same view; and that a well-known clergyman has delivered himself in terms closely akin to those we had ourselves employed. It appears to us that all who have the true interests of religion at heart should take the same view; though we based our own view (as expressed here in a scientific journal) on sociological grounds. There should be no laws on our statute-list which cannot be and should not be applicable to all, high and low, rich and poor, learned or unlearned, cultured or uncultured, well-bred or the reverse.

The Church of England Guild of St. Matthew have memorialised the Home Secretary for the release of the three prisoners convicted at the February Sessions of the Central Criminal Court for blasphemous libel, and have also drawn up a petition praying the House of Commons to repeal all penal enactments against heresy and blasphemy. The Rev. Canon Shuttleworth, writing on the subject of the prosecution, says:—"If blasphemy be an offence against God, then, surely, it is not for man to measure its guilt, or to apportion its punishment. His knowledge is inadequate. God only knows what is a sin against Himself, and what degree of punishment may be deserved in any particular case. Justice would seem to require, then, that the punishment be left to Him. The only essential difference between Mr. Matthew Arnold's sarcasms and the caricatures of Mr. Foote is one of refinement. The one is polished, keen, suggestive, the other rough, outspoken, and coarse. One wields the rapier, the other brandishes the bludgeon. We do not prosecute the scholarly and courteous offender, but if we did, no Court

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of law would punish him. We do prosecute the half-cultured man of the people, and he is sent to prison for a year. That is, we practically punish him, not for blasphemy, but for lack of refinement. Such a reading of the law, judged by the standard of common fairness, not to mention Christian charity, is nothing short of a grave injustice."—*Times.*

There is to be held in Paris this year, from July 1 to the 22nd, an Insect Exhibition organised by the Central Society of Agriculture and Insectology. It will include (1) useful insects; (2) their products, raw, and in the first transformations; (3) apparatus and instruments used in preparation of these products; (4) injurious insects and the various processes for destroying them; (5) everything relating to insectology.

Professor Abel, in a lecture delivered at Glasgow the other day, said there was perhaps nothing more remarkable in the history of industrial progress than the wonderfully rapid strides which had been made in the manufacture of dynamite. In 1867 it was not manufactured in this country to any appreciable extent, and in all only 11 tons were made elsewhere. In 1868 the production had risen to 78 tons; in 1872 to 1,350 tons; while in 1874 the last-mentioned quantity was trebled. Four years later the manufacture had reached 6,140 tons, and last year the production had amounted to 11,000 tons. Those figures did not include the material produced on the Continent. The manufacture of blasting gelatine was developing, and Professor Abel had no doubt that ere long it would be found to usurp the place of its elder brother dynamite, as it seemed in every respect to be the most perfect explosive with which chemists were acquainted.—[This may seem very delightful to Prof. Abel; but with the use to which some persons seem inclined to put these explosives, it is not an altogether cheerful prospect.—R. P.]

An immense number of letters have been sent us to be forwarded to the lady who wrote the article in Knowledge for March 16 on the new skirt. We have not been able to forward all these, nor is it possible for her—she writes—to answer those she has received individually; but she will early (probably in our next) reply in these columns to the points specially inquired about.

The *Chicago Journal of Commerce* (February 21) states that the Chicago and Milwaukee Railroad proposes to test paper pulp rails as a substitute for steel. It is said that the cost per mile is one-third less than that of steel, and that the material is almost indestructible. There is no expansion or contraction from heat or cold, and there are no loose or open joints. Being much lighter than iron or steel, the rails can be made longer, and the connections firmer; and one of the railway officials states that much heavier trains could be hauled over such rails, the adhesion of the driving-wheels of the engine being greater than to steel. An engine can consequently do more work without a corresponding increase in the cost of fuel, while the smoothness of the rail is expected to diminish the wear and tear of rolling-stock. The material used is entirely pressed paper pulp, so solid that the sharpest axe will make no impression on the rails, nor will the action of the atmosphere produce any effect on them.

The *Electrician* says that the wires of the Mutual Union Telegraph Company in Chicago were cut by order of the Mayor on the 2nd inst., because the provision of the franchise which required the Company to put its wires underground by March 1 had not been complied with. The Board of Trade Telegraph Company's wires are said to have been similarly treated.

The Cost of Telegrams.—Dr. Cameron is evidently not disheartened by the failure of his previous efforts to obtain a sixpenny tariff, and has given notice that on an early day he will, on the House of Commons going into Committee of Supply, call attention to the charges for postal telegrams, and move a resolution. We cannot wonder at the hesitation on the part of the authorities to yield, until they are quite prepared, to the pressure thus brought upon them. The existing accommodation frequently proves inadequate, and the increase in the traffic due to such a reduced tariff would doubtless be very considerable.

It is generally allowed that the purchasing power of the shilling was in King Alfred's time about three times as great as now; but then, too, we must remember that, excepting actual rarities, the prices of most commodities were full thirty times under their present rate; hence the shilling has been depreciated during the lapse of a thousand years about 90 per cent. In spite of the terrible social dislocation of the Norman Conquest, however, prices do not appear to have materially risen for some generations, as in 1130 sheep are known to have been sold in this country for 4d. In the last year of the thirteenth century, fowls fetched but 2d., and even as late as the middle of the sixteenth century the prices of beef and pork were settled by Act of Parliament at one halfpenny the pound. Obviously, then, the rise of the price of butcher's meat was extraordinarily rapid. Reference to documents now extant shows that those old worthies, Cranmer, Latimer, and Ridley, when dining at Oxford, were provided with salmon three days running for the very moderate charge of 10d. Their wine—they were probably of the temperance type—makes but the poor figure of 2d.—P. R.

Mr. Proctor's first lecture at St. James's Hall was delivered on Wednesday, March 21, to a magnificent audience—the largest, we are told by those who keep the records, of any which has ever assembled to hear a lecture there. Of the lecture itself we cannot speak here, except to note that Mr. Field, of Chancery-lane, did the work of illustration uncommonly well; but we must express here our sense of the kindness and attention with which the lecture was received by the vast audience. (As Knowledge goes to press on Wednesday afternoon, it was, of course, impossible to give any account of the success of the first lecture of the series in our last number, or of the fortunes of the second lecture in the present number.)

As Mr. Hampden is indignant with us for omitting to insert the denunciatory passages of his articles (he calls them "articles"!), and writes in terms which probably *he* does not consider offensive to the publishers, denying that they are denunciatory, and accusing us of not keeping faith with him, we propose next week to print those omitted passages, but in small type, space being limited, that our readers may see what sort of man the earth-flattener is. After that we promise them that not a line of our space shall be wasted on him.

To make room for some matter, which in reality should have appeared long since in these columns, we omit this week both Whist and Mathematics.

NATURAL LAWS.

A PEACE-OFFERING.

By RICHARD A. PROCTOR.

THE correspondence arising from what I said, not at all thinking to arouse controversy, about the uniform action of natural laws, so far as science extends its survey, reminds me somewhat of a story told by a friend of mine at a dinner of the New York Lotos Club, to which I was invited, in the autumn of 1875. The story is old enough, I dare say; but it was new to me, and may be new to some of my readers. As nearly as I recall it, it ran thus: Davie and Sandy, two Hielandmen, are the *dramatis personæ*; the time some week day. Sandy, perplexed by a profound scientific question, appeals to his friend—"Davie, can ye tell me? Is a pumple-pee a pird or a peast?" Quoth Davie, rather angrily, after reflection, "Hech, Sandie, mon; dinna ye ken that ye mauna speer releegeous questions on ilka day?" A question which to me had no semblance of religion in it, is regarded, I find, by many as altogether religious; and in comments upon what I said, the old and really rather foolish idea crops out that students of science are opponents of religion, glad of any opportunity to sneer and scoff at it. To one who holds, as I do, that to sneer or scoff at views held in esteem by others is simply to be rude and ill-mannered; that the man is most unhappy who is devoid of religion; and that in its sociological aspect religion is the cement which holds together alike the foundation and the superstructure of society, it would be painful, if it were not absurd, to be thought capable of what some few (only, I trust and believe) of my readers seem to impute to me.

I cannot very well either publish or discuss all the letters which have reached me on this subject; because they treat of the religious aspect of the matter, which I had not introduced. But I will take one very kindly letter, accompanied by a pamphlet for my perusal, by the Rev. Canon R. H. Gray, and consider first the bearing of his thoughtful and very fair discussion of a very difficult subject, and then very briefly note what I take to be the view which men who reason at all on the question ought to take, *not* of the subject itself, but of the diversity of views relating to it.

Mr. Gray asks the question, "Should the increase of our knowledge of the laws of nature stop our prayers which have to do with nature?" [There is a comma after the word prayers in his pamphlet, but I think from the reasoning, that the comma is a printer's addition altering the sense, and that Mr. Gray refers to those prayers which have to do with nature, not intending to assert that all prayers relate to natural processes.] He arrives at the following views as worthy of consideration:—

1. Where we have absolutely clear evidence of the way in which natural laws—or God's ordinances—operate, we ought perhaps to reverently tell Him no more of desires to which those ordinances run counter; yet,

2. One must not keep silence as to the possibility of a miracle, as it is called, being worked in answer to prayer. But,

3. We may believe that where science has not yet clearly recognised the operation of laws, or their precise nature, there may be possibility of variation, according to the will of God, adapted to the passing needs of his people. "Things may be as they seem to be, some ruled by an unchanging, some by a changing Will; so that while with fresh light we may transfer events from the latter class into the former, still the classes, being really two, will never blend."

All this is perfectly logical. Every one will admit the reasonableness of (1); no one can expect that the difficult question touched in (2) will be decided by all men in the same way; and assuredly, science has not proved, and is not likely to prove, that the idea suggested in (3) is certainly erroneous.

Still, with regard to (3), the only question which really concerns us, it is, perhaps, natural that science, seeing how the law of uniformity, which has been extended farther and farther throughout the domain over which science extends its survey, is absolutely continuous within that domain, imperfect though our survey of portions of it may be. Nor is the idea of changing Will one which commends itself to all religiously disposed minds (a description applying, be it noted, to many—I believe most—scientific minds). Many will recall a certain description of One with whom is neither change nor shadow of turning, and regard (3) as inadmissible on religious grounds as well as on scientific ones.

Again, it must be admitted that we have very high authority for believing that prayer, intended to express wants felt by us, is not only not an essential part of religion, but is not desirable. In that most beautiful chapter of the New Testament in which true religion is distinguished from the show of religion, a chapter which everyone should know by heart (from my eighteenth year I have known it by heart in the original), we are told that those are mistaken who think they will be heard for their much speaking, that our wants are known before we tell them, and that therefore prayer should take a form very unlike that recently recommended, and later (in relation to another matter) very widely advertised in our newspapers. He who spoke thus was held, we are told by many, as one who scoffed at those outward observances which the Pharisees held dear. And very likely, what he thus taught was held to be very dangerous. Yet I think it is now very generally held to be sound doctrine.

But I do not care to inquire further whether prayer for a change of weather is right or wrong, or even whether the question is a religious one or not. That the question is a religious one to many is enough to make me wish to keep it in future out of KNOWLEDGE, for I wish to offend none of good faith and good will. But in leaving it, and (out of consideration for many good friends) all questions of the kind, I would make a few remarks which bear on the way in which persons who take different views about the question should view *each other*. Let us for a moment compare the Almighty to an earthly ruler of great power, great wisdom, and great love for his people, whom he regards as children, and who regard him as a kindly father. Let us suppose his rules and ordinances to be very much better, much farther-sighted, and more general in their applicability than his people can possibly understand, insomuch that it had never happened within the knowledge of any of them that it had been necessary to interrupt or modify for an instant the action of any of those ordinances. Let it further be supposed that all the wants of every one of this ruler's people were without fail brought to his knowledge. Now, this being so, we can very well imagine that a number of this ruler's people would think it well to tell him of their troubles, almost as though he had no knowledge of them, and even to ask, where no better remedy seemed available, that his ordinances might for a short time be slightly modified, if necessary, in order to bring them relief. One can even suppose that in his kindliness he would take pleasure in hearing their simple supplications, nay, though it seems inconsistent with the idea of the *perfect* wisdom of his ordinances, that he would occasionally see fit to do what they asked him. But it is also conceivable that others, and

not the least faithful, or loving, or respectful of his people would refrain from asking for any such concessions, would even take pleasure in telling him that in their full assurance of the perfect wisdom of his ordinances, they could not ask for anything but that his will should be fulfilled. Now, without asking which of these two classes of this ruler's people would be the wiser, I think I may safely assert that neither of them could reasonably look askance at the other as unloving subjects and an unbelieving, untrusting people. If, then, to apply the parable, anything I have heretofore said on this subject may seem to imply that I regard those who honestly make "prayers which have to do with nature" as showing want of faith in God's wisdom and in His knowledge of their wants, I now definitely say that such doubts would be unfair and unreasonable. But, on the other hand, they should not regard those who find reason (as I must confess I do) for refraining from appeals of that particular kind, as therefore having no belief in God and no faith in His power. We believe the laws of nature to be unchanging, because they are so perfect as to need no change, though, in individual cases, their operation may seem to our limited knowledge to be mischievous or hurtful. Contest between those who see either the silver or the golden side of the shield alone, is beyond question a great and mischievous mistake.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

BESIDES colour-blindness, which is an organic defect, there is an immense deal of insensibility to colour arising from want of practice with the eye and the brain. A majority of uncultivated people never see many of the quieter colours with sufficient discrimination to be in any way impressed by them, or to be able to recognise any differences in those which lie near each other in the colour scale. In actual landscape or in works of art, few persons who have not taken some pains in learning to see, notice half as much as strikes an educated eye, and as the public contains a large proportion of imperfect seers, artists often obtain great praise for scenes in which they have omitted the most beautiful and characteristic chromatic effects; or, if they happen to paint with a wider truth to nature, are told by the critics that they are quite wrong. The microscope when furnished with polarising apparatus offers the readiest means of studying an endless variety of colour contrasts or combinations, and might be of great use to artists and decorative designers.

A few examples will indicate what to do. We will begin with one of the most useful substances for these experiments—salicine. A few grains of this substance should be dissolved in water, and a number of glass slides should have a drop of the solution, in various strengths, put upon them. Some should have the drop evaporated quickly over a lamp, others more slowly, and others left to spontaneous evaporation. By practice, a great variety of crystallised pictures will be obtained. The normal form is that of a circular group of crystals, radiating from a centre, and all in approximately the same plane, though not quite so, on account of variation in the thickness of the needles. The chromatic effects obtainable with the polarising apparatus result from interferences of the light waves analagous to what occurs with sounds when two or more of different pitch are superposed. The slightest difference in the thickness of the crystals that act upon the polarised light gives a difference of colour or tint. Our first experiment is made by placing our polarising and analysing prisms across each other, so that a dark field is obtained. The polariser is placed under the stage of the microscope, and the most convenient place for the analyser is just above the object-glass, and with an arrangement that allows of its rotation. Any optician will show and explain this. Daylight is best for accurate exhibition of all the obtainable colours, and the observer should be a little in the shade, by the side of the window, with the microscope so placed that its sub-stage mirror can easily catch the light. At night, an ordinary paraffin lamp answers well, but its light is a little yellower than daylight, and consequently cannot show some colours. For most purposes this does not matter.

When the field is darkened through the positions of the prisms preventing the transmission of polarised light, a change takes place as soon as the salicine slide is placed on the stage. The circular crystal groups will most likely vary in size and colours. One, for example, in a slide now under view with a 1½-in. objective and its eye-piece, looks the size of a shilling, and it exhibits radiating bands of yellow, greenish-yellow, a rose violet, a dark brown, and a little brilliant blue. Another group, twice as large, shows contrasts of blues, yellows, greens and browns, but no warm reds—or, indeed, any reds. A quarter turn of the analyser changes the scene, and gives blues, reds, and violets, contrasting with white spaces. The effect cannot be called a colour discord, but it is not agreeable. What is the matter? Substituting a 4 in. for the 1½ in. objective at once explains. The field is now much larger, more of the circular groups can be seen at once, and each one is so much smaller that its colour stripes lie closer together, and the whole effect is less violent. The impression is now quite satisfactory, and something like it would do well in decorative art. Using different slides will show to what an extent relative proportion and actual size both have in determining whether a colour composition, not essentially wrong, shall be beautiful or displeasing.

The most charming effects are obtained when a crystalline substance is induced by the sort of treatment already mentioned to do as ice crystals do on our windows—depart from angular and run into curved floral patterns. The slide under examination gives, in one part, an exquisitely quiet design of blues, yellows, and browns, with numerous other tints, the whole suggestive of repose. A slight movement of the analyser makes the same crystals give a rather irritating pattern of blues, yellows, greens, and some little reds. By moving in rotation, sometimes the polariser, and sometimes the analyser, in various degrees, a great variety of experiments may be quickly made.

For another set of observations we will use, besides the polariser and analyser, some thin slices of selenite, called Darker's films. If the observer has not got these, he can make thin slices of mica answer many of their purposes. The apparatus in use at this moment allows the films to be rotated. They are now arranged to give a yellow field, much like pale primrose, which does not fatigue the eye. The whole slide, when introduced, is now beautiful, but in most parts too powerful in effect for steady contemplation. Some parts, however, are soft enough, and we find this modulation is effected by diminishing the size of the brilliant-tinted parts, and introducing more greens and blues. A mauve ground is obtained by another change in the position of the films. This makes the larger crystal groups too violent, but is soft and Indian shawl-like with some of the smaller floral groups. A very pale mauve ground, obtained with another film, succeeds admirably, and

suggests designs for carpets, walls, and pottery. Another combination affords some fine instances of contrast of blues and greens, relieved by delicate touches of appropriate tints from the red scale.

Very quiet steel grey and other hues may be obtained by the polarizer, and analyser in certain positions acting upon very thin filmy crystal groups, such as can be obtained from weak solutions. Many of these look good for nothing until the right position of the prism has been discovered, and they can often be lit up with rich colours by means of the selenite films. A bluish-grey pattern, slightly relieved by pale browns, now before us, is thus instantly changed to a rich violet, relieved with greens.

Endless illustrations of chromatic combinations and contrasts may be obtained in the course of a few hours, and more learnt by them than would be possible by brush and paint experiments in many months.

Practice in colour-seeing makes the eye and brain sensitive to delicate gradations of tertiary tints, but it by no means tends to an exclusive pleasure in quiet combinations. The colour sense is imperfect unless rich bright hues afford delight, but they must be carefully harmonised; and this is a matter of proportion in quantities and intensities, as well as of hues.

Woods in the spring and early summer, where anemones, hyacinths, bears' garlic, and rose campion contrast with many tones of green, the browns and greys of tree trunks, and the red-beech leaves of a former year, display a splendour of colour few artists attempt to rival, and on our Devonshire coasts the sun brings out colours on cliffs and sea profusely gorgeous in brilliancy and depth of tone. Not one twentieth of these things are seen by the unpractised eye; but the ability to see such things may be acquired on a winter's night by the fireside, and with the apparatus named.

THE CHEMISTRY OF COOKERY.

VI.

By W. Mattieu Williams.

THOSE who are disposed to bow too implicitly to mere authority in scientific matters will do well to study the history and the treatment which gelatine has received from some of the highest of these authorities. Our grandmothers believed it to be highly nutritious, prepared it in the form of jellies for invalids, and estimated the nutritive value of their soups by the consistency of the jelly which they formed on cooling, which thickness is due to the gelatine they contain. Isinglass, which is simply the swim-bladder of the sturgeon and similar fishes cut into shreds, was especially esteemed, and sold at high prices. This is the purest natural form of gelatine.

Everybody believed that the callipash and callipee of the alderman's turtle soup contributed largely to his proverbial girth, and those who could not afford to pay for the gelatine of the reptile, made mock turtle from the gelatinous tissues of calves'-head and pigs'-feet. The delicacies of the Orient, the edible birds' nests, the sea-slugs, &c., so highly esteemed for their nutritious properties, are varieties of gelatine.

About fifty or sixty years ago the French Academy of Sciences appointed a bone-soup commission, consisting of some of the most eminent *savans* of the period. They worked for above ten years upon the problem submitted to them, that of determining whether or not the soup made by boiling bones until only their mineral matter remained solid, is, or is not, a nutritious food for the inmates of hospitals, &c. In the voluminous report which they ultimately submitted to the Academy, they decided in the negative.

Baron Liebig became the popular exponent of their conclusions, and vigorously denounced gelatine, as not merely a worthless article of food, but as loading the system with material that demands wasteful effort for its removal.

The Academicians fed dogs on gelatine alone, and found that they speedily lost flesh, and ultimately died of starvation. A multitude of similar experiments showed that gelatine alone would not support animal life, and hence the conclusion that pure gelatine is worthless as an article of food, and that ordinary soups containing gelatine owed their nutritive value to their other constituents. According to the above-named report and the statements of Liebig, the following, which I find on a wrapper of "Liebig's Extract of Meat," is justifiable:—"This extract of meat differs essentially from the gelatinous product obtained from tendons and muscular fibre, inasmuch as it contains 80 per cent. of nutritive matter, while the other contains 4 or 5 per cent." Here the four or five per cent. allowed to exist in the "gelatinous product" (*i.e.* ordinary kitchen stock or glaze) is attributed to the constituents it contains over and above the pure gelatine.

Subsequent experiments, however, have refuted these conclusions. I must not be tempted to describe them in detail, but only to state the general results, which are, that while animals fed on gelatine soup, formed into a soft paste with bread, lost flesh and strength rapidly, they recovered their original weight when to this same food only a very small quantity of the sapid and odorous principles of meat were added. Thus, in the experiments of Messrs. Edwards and Balzac, a young dog that had ceased growing, and had lost one-fifth of its original weight when fed on the bread and gelatine for thirty days, was next supplied with the same food, but to which was added, twice a day, only two table-spoonfuls of soup, made from horse-flesh. There was an increase of weight on the first day, and "in twenty-three days the dog had gained considerably more than its original weight, and was in the enjoyment of vigorous health and strength."

All this difference was due to the savoury constituents of the four table-spoonfulls of meat soup, which soup contained the juices of the flesh, to which, as already stated, its flavour is due.

The inferences drawn by M. Edwards from the whole of his experiments are the following:—"1. That gelatine alone is insufficient for alimentation. 2. That although insufficient, it is not unwholesome. 3. That gelatine contributes to alimentation, and is sufficient to sustain it when it is mixed with a due proportion of other products which would themselves prove insufficient if given alone. 4. That gelatine extracted from bones, being identical with that extracted from other parts—and bones being richer in gelatine than other tissues, and able to afford two-thirds of their weight of it—there is an incontestable advantage in making them serve for nutrition in the form of soup, jellies paste, &c., always, however, taking care to provide a proper admixture of the other principles in which the gelatine-soup is defective. 5. That to render gelatine-soup equal in nutritive and digestible qualities to that prepared from meat alone, it is sufficient *to mix one-fourth of meat-soup with three-fourths of gelatine-soup;* and that, in fact, no difference is perceptible between soup thus prepared and that made solely from meat. 6. That in preparing soup in this way, the great advantage remains, that, while the soup itself is equally nourishing with meat-soup, three-fourths of the meat which would be requisite for the latter by the common process of making soup are saved and made useful in

another way—as by roasting, &c. 7. That jellies ought always to be associated with some other principles to render them both nutritive and digestible.*

The reader may make a very simple experiment on himself by preparing first a pure gelatine soup from isinglass, or the prepared gelatine commonly sold, and trying to make a meal of this with bread alone. Its insipidity will be evident with the first spoonfull. If he perseveres, it will become not merely insipid, but positively repulsive; and should he struggle through one meal and then another, without any other food between, he will find it, in the course of time (varying with constitution and previous alimentation), positively nauseous.

Let him now add to it some of Liebig's Extract of Meat, and he will at once perceive the difference. Here the natural appetite foreshadows the result of continuing the experiment, and points the way to correcting the errors of the Academicians and Baron Liebig. The jellies that we take at evening parties, or the jujubes used as sweetmeats, are flavoured with something positive. I have tasted "Blue-Ribbon" jellies that were wretchedly insipid. This was not merely owing to the absence of alcohol, of which very little can remain in such preparations, but rather to the absence of the flavouring ingredients of the sherry. The *Rahat Lakoum*, or "lumps of delight," sold in the streets of Constantinople, is gelatine flavoured with the unfermented juices of fruit. A privileged visit which I once made to the monster kitchen of the Old Seraglio of his Majesty the Sultan (at Stamboul), lives perpetually in my memory, so sweetly, so vividly, and so gratefully, that when I find myself defending the Turk against the Russian and all his other enemies, my conscience sometimes inquires whether those lumps of delight prepared for the Sultana by his Highness the Grand Confectioner, and presented to me by him as a sample of his masterpiece, may, or may not, have ever after influenced my politics. It was gelatine glorified, once tasted never to be forgotten.

It would seem that gelatine alone, although containing the elements required for nutrition, requires something more to render it digestible. We shall probably be not far from the truth if we picture it to the mind as something too smooth, too neutral, too inert, to set the digestive organs at work, and that it therefore requires the addition of a decidedly sapid something that shall make these organs act. I believe that the proper function of the palate is to determine our selection of such materials; that its activity is in direct sympathy with that of all the digestive organs; and that if we carefully avoid the vitiation of our natural appetites, we have in our mouths, and the nervous apparatus connected therewith, a laboratory that is capable of supplying us with information concerning some of the chemical relations of food which is beyond the grasp of the analytical machinery of the ablest of our scientific chemists.

There is another element of flesh so intimately connected with gelatine and so much like it, that I must describe its properties before going further into the subject of practical cookery of animal food. I refer to *fibrin*, which will form the subject of my next paper.

It is believed that the Edison Company have entered into an agreement to light the General Post Office by means of 1,500 Edison lamps, the current being supplied from the station on the Holborn Viaduct.

* Londe, "Nouveaux Élémens d'Hygiène," Second Edition, vol. ii., p. 73.

"ENERGY."

By E. C. Rimington,

School of Electrical Engineering, Princes-street, Hanover-square.

In looking over some back numbers of a leading electrical journal, I came across the following advertisement:—

A Hint from Poor Man to Electricians and Others.—A properly-constructed permanent magneto-dynamo should offer no resistance to the driving power, except simple friction of bearings. This can be accomplished.

The mere fact of such an advertisement being written must show that there are numbers of persons who do not understand the simplest facts concerning the conservation of energy. I propose in this article, therefore, to set forward, in as simple and untechnical language as possible, a few of the most elementary of these facts.

Perhaps the best definition of energy is "that which is absorbed or transformed when work is done."

Work, consequently, is a transformation of energy. The word work is here used in a sense having a far wider signification than what is popularly understood by the term. If we burn a pound of coal, we absorb or transform the energy contained in that coal (energy stored up in the coal in bygone years, when the light of the sun split up the carbonic acid gas in the air, liberating the oxygen, and depositing the carbon to form wood, which in the course of ages became transformed into coal), we do not destroy it; energy cannot be destroyed, neither can it be created. The energy absorbed in burning the pound of coal is converted into the heat produced; it may be lost for all practical purposes, or it may be employed to perform useful work, as, for instance, to drive an engine. If we wind up the spring of a clock, we store up energy in the spring; when we start the clock and allow the spring to uncoil itself, the energy stored up in the spring is absorbed in doing the work of driving the clock. Again, suppose we put a charge of powder and a bullet into a rifle, then explode the powder; the bullet is propelled out of the rifle by part of the energy stored up in the powder. This may be regarded as the practically useful work done; the other part of the energy stored up in the powder is absorbed in the work performed in heating the rifle, and may be regarded as the practically useless work produced by the absorption of energy. Now, let us suppose that the bullet, upon which work was done, comes in contact with an immovable iron target, the energy stored up in the bullet, by reason of the work done upon it, becomes converted into heat.

If we raise a weight from the ground, thus performing work on it, we store up energy in it, which is greater the higher we raise it, and the larger the weight. On allowing it to fall to the ground, the weight does as much work as was done on it in raising it. The energy stored up in the weight after it has been raised is termed potential energy, and is similar to that which was stored in the wound-up clock-spring. Potential energy is stored up when work is done against forces, which, like gravity, are independent of the motion of the moving body. If, now, we place our weight on a horizontal plane, and move it from one place on this plane to another, we likewise perform work on it. But there is no energy now stored up in it which will enable it to do work in return for the work done upon it. In this case we do work against friction, a force which is reversed as soon as the direction of motion is reversed, and which, consequently, opposes this motion; in overcoming this friction an amount of heat is produced which is equivalent to the work so done. In the heat produced is stored up the energy produced by the work done in moving the weight against the opposing force of friction.

Potential energy is the energy possessed by a mechanical system as regards the relative positions of its different parts with respect to one another.

Kinetic energy is the energy possessed by a mechanical system as regards the relative motions of its different parts with respect to one another.

Maxwell gives the following definition of the principle of conservation of energy:—"The total energy of a system is a quantity which can neither be increased nor diminished by any actions between the parts of the system, though it may be transformed into any of the forms of which energy is susceptible."

That is to say, the energy stored up in any system is a constant, and is always the same in whatever form it may appear, provided it always remains within the system; if, however, for instance, it appears stored up in the form of heat, the heat might be radiated off from the system to surrounding objects or into space, the energy stored up in the system would then, of course, be diminished.

Although energy cannot be destroyed, and must always exist, all the energy at present available for useful work may become in the course of time only available for work useless to man; and this transmutation of useful energy into useless is one of the theories of the end of the world, which would then become dead, as the moon is now supposed to be.

Returning to the advertisement quoted in the commencement of this paper, if the magneto machine were simply required to rotate, the only work that need be expended would be that necessary to overcome the friction of the bearings and of the air (which latter, by the way, the writer of the advertisement altogether ignores), and although this may be reduced to a minimum, it can never be altogether overcome, except by running the machines in vacuo, which is, of course, utterly impracticable. But in order to produce a current of electricity at all, we must expend work, and consequently absorb energy, which reappears in the heating or other effects produced by the current.

The work required to produce a current of electricity varies as the square of the current multiplied by the resistance opposing the passage of the current. The resistance opposing the passage of the current may consist, either of the resistance of the conductors conveying the current, which is analogous to the resistance to a current of water flowing in a pipe caused by the friction of the water against the inside of the pipe; or of an opposing electromotive force, tending to produce a current in the opposite direction, which is analogous to back pressure in the case of a current of water.

This current of electricity produced by the rotation of a dynamo machine may be employed to do mechanical work, such as to turn an electromotor, and thus drive some machine, or to produce heat, as in the case of the electric light. In the case of a current produced by means of a battery, the work that has to be expended to produce the current is the result of the absorption of the energy that was stored up in the zinc when it was separated from oxygen, for which it has a natural affinity.

It is thus impossible to produce a current of electricity, either by means of a battery or by means of a dynamo or magneto machine, without the absorption or transformation of energy.

I also noticed, some months ago, a paragraph which appeared, I think, in one of the daily papers. The gist of the paragraph was this. A number of accumulators or secondary batteries, that had been charged by passing a current of electricity through them, were to be employed on board a vessel to drive an electromotor, which was to be attached to the screw, and thus propel the boat, the forward motion of which was then to drive a dynamo, from which the accumulators could be recharged.

The wiseacre who wrote this article evidently did not perceive that if this were possible we should obtain perpetual motion without further trouble, which, by the theory of conservation of energy, is impossible. The energy stored up in the accumulators is absorbed in producing the work necessary to propel the vessel, and in order to turn the dynamo for the purpose of recharging the accumulators, or, what amounts to the same thing, make the forward motion of the boat do so, we must expend the work necessary to produce the required current and to overcome the friction of the bearings of the dynamo, &c., which will absorb energy. So we should have to take out of the accumulators the energy absorbed in performing the work of propelling the boat plus the energy absorbed in performing the work of driving the dynamo, while the quantity of energy we should store in these or other accumulators that were charged by the dynamo would be the energy absorbed in producing the work requisite to turn the dynamo minus the energy absorbed in the work of overcoming its friction and of heating its coils. We should thus be actually converting useful energy into useless energy. By useful energy, I mean energy that can be employed to perform useful work: such work cannot be obtained from energy stored up in the heated bearings and coils of a dynamo.

HOW TO USE OUR EYES.—IV.

By John Browning, F.R.A.S.

(*Continued from p.* 162.)

A GREAT many persons have one eye more sensitive to colour than the other, and this leads me to say that many more persons than would be supposed have two odd eyes. In some, the eyes differ in colour; in others, in focus; and again in others, in their sensitiveness to light. In some cases, when spectacles are required, the difference between the eyes may be corrected by using lenses of different power.

And here I may, with advantage, give a few hints on spectacles—a subject on which the public have less general knowledge than any with which I am acquainted. As a result of this, there is probably more quackery practised in this direction than in any other.

It is, above all, when we have passed middle age, and are compelled to apply to the optician for artificial aid to vision, that we require to know "how to use our eyes."

We are all interested in spectacles, for those of us who do not require them ourselves have relatives or friends who do, and we may save them from having their pockets picked or their eyesight injured.

There is no particular age at which spectacles are certain to be required. Men can seldom see well without them after they are forty-five, or women after forty. Very often indeed women require them at thirty, and do themselves irremediable injury by not using them. In many cases they fear looking old, but more often they think that the longer they can put off using them the better. This is a great mistake. Once they cannot see clearly by lamplight or gaslight without holding the object further from them than usual, they require spectacles, and by working or reading without them they may bring on distressing headaches, or do their eyes an injury which no optician can afterwards remedy.

A correspondent of mine has aptly named the stage at which spectacles are first required as becoming "Bradshaw blind."

XUM

As soon as it is found that the figure 3 cannot be distinguished from 5 in the popular railway guide by artificial light, spectacles should at once be obtained.

A worse mistake than postponing getting a pair of spectacles suited to their own sight, is to use their father's or mother's spectacles, if they have such by them. By doing this, they may in a few months age their eyes as much as with the use of proper spectacles they would have aged in as many years.

These remarks apply quite as much to gentlemen as to ladies.

Another mistake, commonly made by short-sighted persons, is wearing the same spectacles for reading and walking. This can seldom be done without straining the eyes.

Nearly all short-sighted persons require two pairs of spectacles, and these often differ widely in focus. Occasionally those suited for reading require to be only half the focus of those suitable for walking.

At times the power of accommodation is so deficient that three pairs of spectacles are required to see objects at different distances, say, from reading-distance to the horizon.

Different spectacles should, as a rule, always be worn for playing music to those used for reading.

Although, of course, the power of adapting the vision or seeing clearly is, as a rule, first lost for close objects, yet occasionally it is first lost for distant objects.

I have known persons who fancied that their eyesight was seriously and permanently impaired from being unaware of this fact.

A pair of short-sighted spectacles gave them clear vision directly.

Fig. 6.

Fig. 7.

No attention is generally paid to a pair of spectacles fitting the face, yet, to obtain the full benefit from them, they ought to fit the wearer's face so well that the centres of the glasses come exactly opposite to the pupils of the eyes. It is curious that people who would never think of wearing a dress or coat unless it fitted them, will wear any pair of spectacles, though the result is more disfiguring and often injurious to the eyes. It is necessary to keep at least seven different patterns of spectacles to select from, and even then spectacles must often be made to fit the face, and this should really add very little to their cost. If the spectacles are either too wide or too narrow, as shown in the diagrams, they have a tendency to produce double-vision, that is, to make every object appear to be doubled. In Fig. 6 the spectacles are too wide; in Fig. 7 they are too narrow, and in Fig. 8 they are the correct width.

Two things I must earnestly warn you never to do. Never use a single eye-glass (Fig. 9), and never keep a pair of spectacles on your face that are suited for reading when you are walking about, or, in fact, one moment after you have done looking at some near object through them.

While I was reading this for the press I received a letter from a lady who had fallen down stairs in her spectacles and broken them. Most likely the spectacles were the *cause* of the accident.

Fig. 8.

Fig. 9.

Very recently I saw a gentleman in the Charing-cross Railway Station wearing a pair of reading spectacles. With these on he was trying to make out the time by the station clock. This clock must be about thirty or forty feet high, and he was straining his eyes to see it through a pair of spectacles which would not show any object clearly at a greater distance than eighteen inches.

By wearing them he was seriously injuring his eyes, and risking an accident in getting in and out of the railway carriages. Fig. 10 illustrates the effect of a person looking at a church clock under similar conditions.

Fig. 10.

I have traced many accidents to persons who were long sighted keeping on their spectacles when going down stairs.

(To be continued.)

The Electric Light in Switzerland.—A *Daily News* correspondent says that a scheme is proposed for lighting the whole of the Canton of Vaud by electricity. The motive force would be derived from turbines of 5,000 horse-power at Vallorbes, and, the water supply being constant and abundant, it is believed that gas, which is very costly in Switzerland, may be entirely dispensed with throughout the district.

THE GREAT COMET OF 1882.—IV.

BY PROFESSOR C. A. YOUNG.

(*Continued from page* 161.)

ON Sept. 17 the comet passed its perihelion at a distance of about 750,000 miles from the sun's centre, and within 300,000 of its surface, rushing through the coronal regions with a velocity exceeding 300 miles per *second:* it swept over 180° of its orbit in three hours and a-half. Thus far we find in our lists of cometary orbits only four with so small a perihelion distance, viz., the comets of 1668, 1680, 1843, and 1880. (As to the comet of 1668 there is some doubt, because it was only observed for about three weeks, and its motion during that time was such that it answers almost equally well to either of two quite different orbits.) There are half-a-dozen others with perihelion distances between one and a-half and five million miles, viz., comets of 1767, 1816, 1826, 1847, 1865, and 1870; and Wells's comet, which disappeared only a few weeks ago, is just outside that limit, with a perihelion distance of 5,675,000 miles.

Now, as to the comets of the first class, we find that, excepting that of 1680, their orbits are extremely similar; their plane and direction of motion are almost exactly the same; the perihelion distances are nearly the same for all; and the axes of the orbits all point to the same part of space; they have all come toward the sun from the same region of the heavens, in the immediate neighbourhood of the great star Sirius. In the little table below are given what are called the elements of their orbits: Ω is the longitude of the node, i the inclination of the orbit to the ecliptic, π the longitude of the perihelion, and q the perihelion distance, expressed as a decimal fraction of the earth's distance from the sun; e is the eccentricity of the orbit; and the — in the last line denotes that the motion is retrograde. The orbits of the first two are from the catalogue in Chambers's "Descriptive Astronomy"; that of 1880 is the orbit computed by Meyer, of Geneva, from the whole assemblage of observations, and that of 1882 is the last orbit computed by Mr. Chandler, of Cambridge, and may be found to need some correction when later observations come to hand. Fig. 4 shows in a rough way how these orbits lie in relation to the orbit of the earth, and how very long and narrow the comet's orbit is as compared with the circle described by the earth.

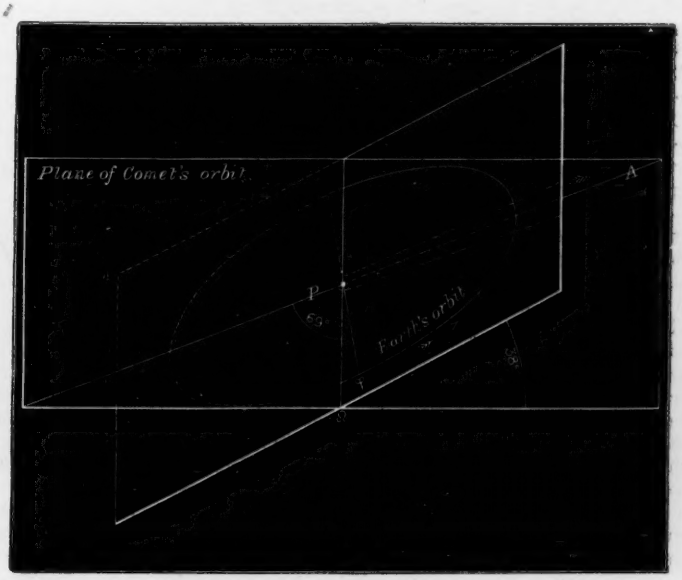


Fig. 4.

	1668.	1843.	1880.	1882.
Ω	357° 17′	361° 12′	356° 17′	345° 50′
i	35° 58′	35° 41′	36° 53′	38° 05′
π.....	277° 2′	278° 39′	278° 23′	276° 28′
q	0·0047	0·0055	0·0059	0·0076
e.....	1·0	0·99989	0·99947	0·99997
Direction ...	—	—	—	—

Now, the similarity between these orbits may be explained in two different ways. It might be accounted for by supposing that we have to do with different visits to the sun of a single comet, or that we have here a group or family of comets, very likely of common origin, but separate, and following each other. Hoek, of Utrecht, showed some years ago that such comet-families exist. When we compare the orbits of the comets of 1843 and 1668 there is nothing that forbids the idea of their identity. The differences are no greater than probable perturbations might account for. Then, again, the comets of 1843 and 1880 may easily be identical. Indeed, the orbit given for the latter comet corresponds to a period of almost thirty-seven years, and Meyer has shown that the observations cannot be reconciled with a period less than thirty or greater than fifty years. Now, thirty-seven years would take us back just to 1843, so that it is very likely that these two comets are really one and the same. So far the "identifiers" have matters their own way. But now, as to the comet of 1882. Can it be identical with the comet of 1880? We think not. The orbit of the latter was computed exclusively from observations taken *after* its perihelion passage, so that no action of the *sun* depending upon its close approach at perihelion can account for its return in less than three years, and the inclination of its orbit is such that ever since it went out of sight it has been out of harm's way as to perturbations by the *planets*. Then, again, the orbit of the comet of 1882 does not agree with the idea of identity. Whatever other effects may have been produced by the resistance of the solar atmosphere at perihelion, this resistance must have tend to *shorten* its period, if it changed it at all. No the observations thus far taken, though perhaps not sufficient to settle the orbit definitely, seem to be absolutely inconsistent with a period of anything like three years (corresponding to an eccentricity of 0·9963). The period can not be well less than ten or twelve years, according to the last results, and may be several thousand. It is to be noted, further, that, as regards Ω and q, the two orbits differ more than can well be consistent with the theory of identity. It seems to be an almost necessary consequence that these two comets cannot be identical with each other, though they may, perhaps, both be fragments of 1668 or 1843, or of some comet more ancient than either.

It is an interesting fact that Mr. Chandler finds that his orbit, computed entirely from post-perihelion observations, satisfies almost exactly the observation of Mr. Finlay, taken on September 8th, as well as the observation of the comet's disappearance at the sun's edge. If the observa-

tions of Dr. Gould, when they come to hand, agree as well, it will be proof positive that no sensible resistance or disturbance of any kind was suffered by the comet in passing within 300,000 miles of the sun's surface at the rate of 300 miles a second.

Of course, if the view we have taken is correct, there is no possibility that our comet can return in six months and fall into the sun. Not that there is any *absurdity* in the idea by itself considered. If the comet of 1880, when receding from the sun, had moved in an orbit corresponding to a three years' period, and if the present comet were found to have a period of three years or less as it is now receding from the sun, it would be almost impossible to refuse to admit their identity, and probable speedy absorption in the sun.

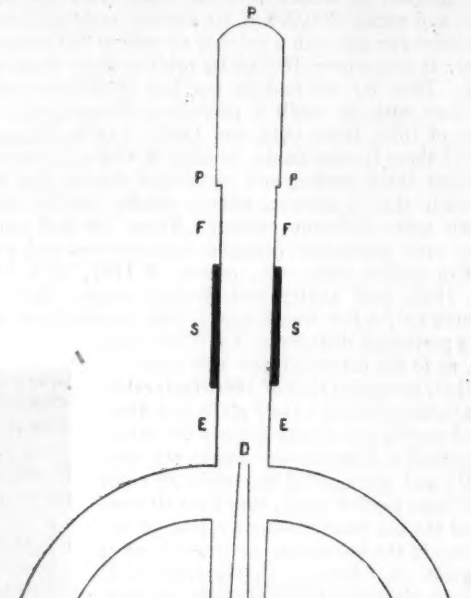
We close with a single word as to the probable consequences of a comet's fall upon the sun. Unquestionably, the energy of the comet's motion would be transformed into heat, and if the comet had any considerable mass, say $\frac{1}{100}$ the mass of the earth, the heat produced would be enough to supply the sun's heat-expenditure for months. Probably, however, no comet has a mass anything like so great as that; more likely the present comet even, huge as it is, has a mass less than $\frac{1}{1000000}$ of the earth's, so that its collision with the sun would produce as much heat only as the sun would expend in eight hours.

Now, if the sun were a cool, solid, or even liquid mass, the sudden accession of merely this quantity of heat would undoubtedly produce an enormous rise of temperature and a great increase of radiation. But, constituted as the sun is—mainly a mass of gas and vapour—the effect would be entirely different, the energy being principally expended in producing expansion and evaporation, with comparatively little increase of temperature or radiation. If one stirs up the fire under an open kettle, the water gets no hotter—it only boils faster. Probably the effect of the fall of a body, even as large as the earth, upon the sun, would be hardly anything more than to restore the sun to the condition it was in a century ago. The energy lost in the course of a century would be replaced—that is about all. During the few moments while the body was passing through the sun's atmosphere, there might be, and probably would be, phenomena of great interest and beauty to those who were on the watch; but it is very doubtful whether people generally would know anything about the occurrence until they read of it in the papers.

THE CRYSTAL PALACE ELECTRIC AND GAS EXHIBITION.

THERE is not much in the way of progress to record in the electrical section. The north nave is tolerably well filled with various exhibits, while preparations are rapidly approaching completion for what promises to be a gorgeous display by the Gulcher Company of Gulcher arc and Crookes incandescent lamps. We hope to be able to give a detailed account of this exhibit when it is finished. The Duplex Company's exhibit has been withdrawn, owing, it is said, to pressure of business elsewhere. One of the most satisfactory features of the exhibition is the illumination of the space in front of the theatre by half-a-dozen Fyfe-Main arc lamps. Their light is remarkable for its steadiness and brilliance, and fully confirms the impression created on the occasion of their first exhibition at the office of the *Daily Telegraph*.

Turning our attention to the more extensive Gas Exhibition, the incandescent and regenerative gas lamps remain the striking features of interest. According to the catalogue, there should have been four systems of incandescent gas-lighting exhibited, but only three of them are to be seen. First amongst them we may mention the Lewis burner, which is illustrated in the accompanying sectional diagram. Gas at the ordinary pressure is supplied to the



outer pipe or tube, A A. Air under a pressure of 12 in. of water, after passing through the inner tube, B, mingles at D with the gas in A. The mixture then passes through the series of tubes, E S F, to the combustion chamber, P, which consists of a small cap of fine platinum wire gauze. The volume of air passing through B is three times the volume of the gas consumed, and the force of the current passing upwards "induces" another volume of air through the two tubes C C. The gas is first turned on gently, and then lighted, and the quantity increased until the flame is no longer seen, when the platinum commences to incandesce or glow. The quantity is gradually increased until the cap become brilliantly and uniformly luminous. This, then, is the principle of the flameless incandescent gas-light, and one great advantage pertaining to it is that the proportion of consumed to unconsumed is very considerably increased; while again, it may be utilised for the consumption of gas inferior to that usually supplied for lighting purposes. S S is a short tube of steatite, which, being a non-conductor of heat, prevents the heating of the lower parts of the burner. It is claimed that the light is equal to five candle-power per foot per hour, so that as the ordinary sized Lewis burner, with a platinum cap half-an-inch in diameter and an inch or so long, consumes eight feet of gas per hour, its luminosity is equal to forty candles. An ordinary gas jet consumes about five feet, giving a light of sixteen candle-power. It is also worthy of consideration that the "carbon in the gas is so perfectly consumed that a polished silver reflector, placed immediately over the burner, is not tarnished in the slightest degree."

The cost of the compressed air is naturally an important consideration, more, perhaps, on account of the extra piping

and apparatus requisite for the purpose. It is stated, however, that arrangements are nearly completed for supplying this air locally, by means of a small apparatus, about the size of an ordinary gas-meter, which will have a capacity sufficient to supply a dozen burners. At present, the cost for air is about fourpence for every thousand feet of gas consumed. Considering that there is a clear saving of 50 per cent. in the gas bill, this trivial cost for air is of comparatively little moment.

While we may conscientiously say the light is all that could be desired so far as gas-light goes, there is to be considered the objection there would be to the application of the system to domestic purposes, consequent on the slight hissing noise that attends this mode of illumination.

In order to further reduce the cost of his system, Mr. Lewis has, we hear, patented a burner in which the gas is subjected to a pressure of 12 inches, and is then able to induce the whole of the air necessary to complete the combustion.

M. Victor Poff, of Paris, exhibits a somewhat similar arrangement. Two separate pipes run together until close to the burner, one supplying ordinary gas, and the other air at a very considerable pressure. The burner consists of a platinum gauze cap, inside which is a cap of perforated steatite, which covers the delivery-pipe. The mixture of gas and air is, therefore, forced through the small holes in the steatite, on the surface of which it burns, and in so doing renders the adjacent platinum cap incandescent. The luminous efficiency claimed is the same as in the case of the system previously described. The burner gives a soft, steady light, and in Paris, where the inventor has the use of the subways, it will most probably prove very successful, but the difficulties it has to contend with in London are, we fancy, too great to render its adoption generally practicable. This will be apparent when we reflect that it will necessitate opening the streets to lay a fresh system of pipes, to say nothing of the heavy expense that would be incurred in maintaining the requisite air-pressure.

M. Edouard Servier, another Parisian engineer, exhibits in the Chinese Court the Clamond incandescent burner, in which gas mixed with air at a slight pressure, but raised to a very high temperature, burns in a cap or basket of magnesia threads. These threads require, however, to be renewed every forty hours, a fact that will weigh very largely against them in the estimation of most consumers. The light is good, but somewhat irregular, its brilliance declining with the age of the magnesia.

We regret our inability, through want of space, to refer in detail to either of the regenerative burners. It is noteworthy, however, that a new one has just been exhibited, which is the production of Messrs. Bower & Grimston. The gas, accompanied by heated air, descends by vertical tubes, &c., and, impinging on a refractory cone, is reflected in a state of combustion in a horizontal plane. The flame thus forms a horizontal ring, over it being a ring of fireclay, one of the functions of which is to reflect the light emitted by the upper surface of the flame. The efficiency of this burner is seven candle-power per foot per hour, and we believe that its excellence has evoked the greatest interest. We hope, therefore, to describe it more fully in our next notice.

Attention has been called to the rapid and considerable deterioration of the plants in the Palace, and the cause is attributed to the deleterious products arising from the enormous amount of gas consumed every evening. There are about sixty-two large lamps suspended from the roof, and they consume together as much as 9,500 feet of gas per hour. A small proportion of imperfect combustion would, therefore, suffice to charge the atmosphere very extensively with the highly injurious gas, carbonic oxide (CO), perfect combustion yielding the much less hurtful carbonic anhydride (CO_2). We believe, however, that gas is in this case somewhat unfairly charged, and that age, etc., has a great deal to do with the decay complained of.

THE FACE OF THE SKY.

FROM MARCH 30 TO APRIL 13.

SPOTS, faculæ, &c., should be watched for as usual on clear days The Zodiacal light is still visible after sunset. The aspect of the Stellar Vault may be found from Map IV. of "The Stars in their Seasons." Mercury, Venus, Mars, and Neptune are, for our present purpose, invisible, while Saturn must be looked at as soon as ever it is dark enough for him to be seen. Jupiter, too, is now rapidly approaching the west, and must be observed as early in the night as possible. He travels away in a north-easterly direction from ζ Tauri. To-night (the 30th), at 9 h 32 m. 20 s., Satellite I. will reappear from eclipse, as will II. on the 31st, at 8 h. 35 m. 14 s. p.m.; Satellite III. will afterwards disappear in eclipse at 9 h. 16 m. 41 s. to reappear 4 m. 49 s. after midnight. On April 4, Satellite IV. will be eclipsed at 9 h. 33 m. 54 s., and reappear at 10 h. 59 m. 48 s. A transit of Satellite I. will begin at 10 h. 43 m. on the night of the 5th, and Satellite II. will follow it on to Jupiter's face at 11 h. 32 m. On the 6th, Satellite I. will be occulted at 8 o'clock, and reappear from eclipse at 11 h. 28 m. 3 s. On the 7th, an occultation of the IIIrd Satellite will happen at 8 h. 20 m.; the egress of the shadow of Satellite I. occurs at 8 h. 42 m.; Satellite II. reappears from eclipse at 11 h. 10 m. 38 s.; and III. reappears from occultation at 11 h. 11 m. On the 12th, the student should look out for a portion of the transit of Satellite IV. over Jupiter's face, for the reason we have more than once given. Ingress will take place in twilight at 7 h. 32 m., but egress may be observed at 8 h. 32 m. Uranus continues above 89 Leonis, but is now travelling somewhat to the right.

As the moon does not rise until after midnight to-night, and, of course, gets later and later every night, we may regard her as invisible up to April 10th, when she will be 2·9 days old at Greenwich mean noon. At this instant she will be in Taurus, through which constellation she will travel during the next twenty-four hours, passing north of the Hyades. During the 11th she will pass through the remaining part of Taurus, and be found at noon on the 12th on the northern confines of Orion. Between 0 h. on the 12th and the same time on the 13th she will pass into Gemini. She will occult the 3½ mag. star λ Geminorum at 8 h. 20 m. p.m. on April 13th at an angle of 58° from her vertex, the star reappearing at an angle from her vertex of 342° at 9 h. 6 m. p.m. This is calculated, of course, for Greenwich; for other latitudes a correction must obviously be made for the parallactic displacement of the moon in the sky.

IMPORTANT ELECTRICAL EXPERIMENTS.

A SERIES of experiments were made with the Elphinstone and Vincent Dynamo Machine, on the evening of Wednesday, February 21st, at Messrs. Unwin Brothers' printing-office, The Gresham Press, Little Bridge-street, Ludgate-hill, in the presence of a large and distinguished company, among whom were the following:—Earl of Dunmore, Lord Saltoun, Count Gleichen, Viscountess de Vesci, Lady Elphinstone, Lady A. Murray, Lady K. Carnegie, Honourable C. Murray, Honourable E. Elphinstone, Honourable A. Fraser, Sir R. Burnett, Bart., Sir Archibald Campbell, Bart.; Admiral Herbert, Captains Tryon, R.N., Wilmot, R.N., Brine, R.N., and Lieutenant Rogers, R.N., from the Admiralty; Captain Shaw, Metropolitan Fire Brigade, and his two sons; Mr. and Mrs. Hichens, Mr. Fraser Rae, Mr. Spottiswoode, D.C.L., Mr. Warren De La Rue, D.C.L., Mr. George Stephen (President of Canada Pacific Railway), Mr. Wm. Winter, Mr. W. Elphinstone &c., &c.

The guests assembled in a large warehouse on the first floor, along the ceiling of which, and grouped together, were suspended 350 Swan incandescent lamps, each of 20-candle power. These were brilliantly illuminated, and produced a most dazzling effect. Lord Elphinstone explained that the machine was capable of driving 416 Swan lamps, but owing to delay only 350 could be set up. Mr. Vincent, in a brief address, explained the construction of the machine, remarking that it was the outcome of strictly following Faraday's researches, excluding everything which tended to militate against the conclusions drawn by that eminent philosopher. The dynamo, which is claimed to be one of the most powerful continuous current machines ever made, is of an entirely new design, patented by

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Lord Elphinstone and Mr. Chas. W. Vincent, and it is believed that it is destined to take a very important place in the history of electricity. All the electricians and electrical engineers who have seen it have been much struck with the way in which correct electrical and engineering principles have been combined, and the necessity for skilled manual labour avoided in its construction. For instance, the coiling of the armature is effected in the course of a few hours, and the whole machine can be taken to pieces like a clock, and put together easily in three days.

Among other experiments shown, a length of about 40 ft. of galvanised iron wire ½-in. thick was rendered red hot. As the heat increased, the zinc burnt off in brilliant coruscations, forming an electrical firework of great beauty; the heat still increasing reached whiteness, and finally the wire fused, parts of it, as it struck the floor, breaking up into brilliant globules of melted wrought iron. Lengths of steel and also copper wire each became in turn incandescent, the steel being fused. The current was then made to run through a coil of iron wire immersed in a glass vessel holding three quarts of water; instantly there was a hiss, as when a red-hot poker is plunged into water. This was followed almost immediately by steam; in half a minute the water boiled, and before a minute had elapsed half the contents of the vessel were on the floor. An ordinary steel flat file 1-in. by ¼-in. was then placed instead of one of the carbons in an arc light, and the current being passed through, the end of the file was melted and consumed like a tallow candle in a fire, throwing off a shower of sparks with a Catherine-wheel-like effect. The experiments concluded by the lighting up of a very powerful "Search Light," as used by the Navy, the carbons of which are 1¼-in. in diameter, capable of giving a light equal to 100,000 candles. This was a brilliant display, far too dazzling to look upon, except with the aid of coloured glass.

The whole of the mechanical arrangements were carried out by Mr. Arthur Rigg, engineer to Lord Elphinstone and Mr. Charles W. Vincent, under the superintendence of Mr. S. G. Wilmott, his manager, who also assisted Mr. Vincent with the electrical display. The motive-power used for driving the dynamo-machine was supplied by one of Rigg's patent high-speed engines, capable of developing 60 indicated horse-power. The patentees are now in a position to supply these machines, and can be communicated with at their office, 79½, Gracechurch-street.

Prior to the electrical experiments the party was conducted through Messrs. Unwin Brothers' extensive works by their manager, Mr. W. B. Marr, and as many of the processes of printing were seen for the first time, much interest was excited, particularly among the ladies, in all that they saw. In fact, the pleasure of the visit may be said to have been fairly divided between printing and electricity. On the lighting up of the "Search Light" for the first time, a false alarm of fire was raised, and as a memento of this visit to The Gresham Press, a reprint of the newspaper record of this amusing incident was presented to each visitor by Messrs. Unwin Brothers.

LOGICAL PUZZLE.

I STILL receive letters showing that, after all, this is a puzzle to many. One correspondent, A. M. S., gives arguments leading up to this as simplest illustration of the wrongness of the syllogism which I had ascribed as evident.

"There are 10 football players (Z); and there are 10 non-rowing (not Y) cricketers (X); 4 men who row (Y) play football. The fact that 4 men who row play football does not make them cricketers. Therefore, unless some Y can only mean some X's which are Y's, the conclusion—some cricketers are not football players *may* be true, but is not necessary." I should have thought it absolutely necessary, whether the 4 Y's are cricketers or not. There are 10 football players, of whom 4 are rowing men, leaving only 6 non-rowing football players, whereas there are 10 non-rowing cricketers; must not 4 at least of these be not football players?

Another correspondent, W. B., thinks that because for every Z there is an X which is not Y, every Y which is, or, as he writes, becomes a Z, becomes also an X, "for there is no Z without a corresponding X." Taking the above example, which gives for every Z a corresponding X, do the rowing men who play football necessarily become cricketers?

Mr. W. H. S. Monck writes that the syllogism cannot be called a puzzle. It was De Morgan, great in logic, who presented it as one. *I* have always said it is not one. Mr. Monck, as a writer on logic, defends the study of logic; but I do not find that logic, as he defines and defends it, is more than the analysis of the ways in which men reason. He quotes Mill (J. S.) as saying that in cases of doubt we must throw our reasoning into the syllogistic form. The best proof that this is not so is found in the great number of men noted for their skill in reasoning about doubtful and difficult matters, who either know nothing of syllogisms or never use syllogistic reasoning.

Mr. S. E. Clark finds a difficulty which has no real existence. He doubts whether, because the X's, which match the Z's numerically, are not Y's, we can infer that the YZ's are not to be counted as against these, and seems to think the syllogism not a numerical question. But this is just what it is.

F.R.A.S., (2), however, is right in saying De Morgan's syllogism is very loosely worded.

Our Paradox Corner.

FLAT EARTH *versus* GLOBE.

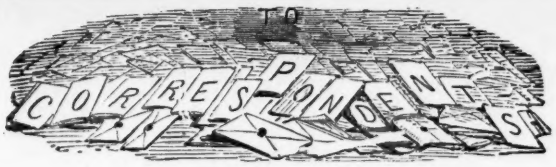
I HAVE published every line of description or explanation which Mr. Hampden has sent me; besides, in his first paper, what was neither descriptive nor explanatory, but simple abuse of the accepted views and those who believe in them. About as much of the same kind, accompanying his last contribution, I excluded as a mere matter of justice to readers of KNOWLEDGE.

His diagram, in the last number, of course explains itself. It suggested certain questions which, were his theory sound, he could readily answer. But he declines to attempt this. He considers, or rather *says*, that these questions have "nothing whatever to do with his subject,"—on which point I may safely leave readers to judge for themselves. He will, therefore, write no more. But this is no great loss, as he has already written enough. His theory, as Professor De Morgan long since said of it, is worth examining. It shows what absurdity men can believe; for Mr. Hampden really believes, as he says he does; whereas the original founder of this flat earth theory was by no means so simple.

I am a little pleased with my new invention for silencing paradoxists. Reasoning has been tried in vain (one can furnish reasons, but of what use are they without understandings to match?); ridicule is ineffective, and a bad example; denunciation is idle. The plan with paradoxists is to ask them to explain their views and to remove the difficulties, which are, of course, in reality fatal. They either give up the attempt in despair, like our enthusiastic earth-flattener, Mr. Hampden, or flounder so absurdly in their efforts to explain their preposterous notions, that even the unlearned (for whom alone, of course, the thing is done) see at once how hopelessly at sea the paradoxists are.

R. A. PROCTOR.

IT is a popular belief, easily sustained by statistics, that we live in an age remarkable for an excessive devotion to literature, and that the number of writers is inordinately great. We are not prepared to dogmatise on the proportion that the literary class should bear to the rest of the community, but it may interest, and at the same time inform some persons, to state that more than a century-and-a-quarter since the above assertions were authoritatively made, and that, too, when the population was reckoned to be in England and Wales only 7,055,706! If we turn to a once famous work, "Magnæ Britanniæ Notitia; or the Present State of Great Britain," by John Chamberlayne, we find in Part I., page 188 of the thirty-seventh edition, the following remarkable passage:—"The English are so much given to literature, that all sorts are generally the most knowing people in the world; men and women, children and servants cannot only read but write letters, to the greatest increase of commerce and the prodigious advantage and augmentation of the post-office, in proportion beyond any other post-office in Europe." This is much, but it is far from all, for the writer goes on to say:—"The English have been so much addicted to the writing of books, especially in their own language, and with so much licence, that there were, during our late troubles and confusions" [alluding to the Jacobite movements prior to and during the reign of George II., to whom the work whence we quote is dedicated], "more good and bad books published in the English tongue than in all the vulgar languages of Europe." This is another example of the fact, too little recognised, that the grumblings of one generation greatly resemble those of another, and, as a further illustration, it may be added that in the *Spectator* are two papers complaining, respectively, of ladies adopting a too manlike style of dress, wearing hats and coats similar to those of the sterner sex, and lamenting over the excessive number of young men who were rushing into the liberal professions, already so overstocked, that the vast majority were foredoomed to failure. Truly there is nothing new under the sun!—P. R.



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO, DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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The Editor is not responsible for the opinions of correspondents.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

SCIENCE AND RELIGION.

[770]—While certain bigoted professors and preachers of the Christian religion of the type of Mr. Talmage, of America, are hurling the shafts of their vulgar eloquence at the heads of such men as Darwin, Tyndall, Huxley, Herbert Spencer, and others, it is pleasing to hear, by way of contrast, words such as these, fall from the lips of a more liberal minister of the Gospel:—"Christ is always saying, 'Other sheep I have which are not of this fold; them also I must bring.' And I see them coming in, I do—the men that are now supposed not to belong to us; I see the mighty and brilliant host of Huxleys, and Tyndalls, and Herbert Spencers and others, that are supposed to be outside. They are not outside really, but they have got a way of saying things which we do not always understand. They are trying to come in by a road we have never travelled—a high, rocky road we could not climb by reason of feebleness; and what if God should meet them and say [quoting the text], 'I girded thee, though thou hast not known me'"—uttered in the course of a sermon preached by the Rev. Dr. Parker, in the City Temple, last Good Friday morning, on behalf of the Haverstock Hill Orphan Working School. Of course, too much weight is not to be attached to this particular utterance, being an almost parenthetic allusion cut out of the centre of a discourse bearing upon another subject; but these are the kind of remarks that promote, at least, good feeling between scientists and theologians, if they cannot create actual union upon controversial points. A LOVER OF KNOWLEDGE.

MAGIC-LANTERN SLIDES FOR POPULAR LECTURES.

[771]—Can any of your readers tell me where it would be possible to hire or borrow magic-lantern slides of Norwegian mountain scenery? The Norwegian slides in the optician's catalogues I have consulted are very unsatisfactory, consisting merely of public buildings in the capital, with no views characteristic of the fiords. A gentleman has offered to give one of the Friday evening Penny Lectures at the Victoria Hall on Norway, but the Victoria Hall audience cares little for a lecture unless it is addressed to the eye as well as the ear. And on the whole they are right. Those who have never seen a mountain need the help of pictures in order in any degree to realise what a lecturer means when he speaks of one. Therefore any information as to where such views can be obtained will greatly oblige, ONE OF THE VICTORIA HALL COMMITTEE.

PLANCHETTE WRITING.

[772]—The letter of "T. P. B." will interest many who think, as I do, that "some yet unknown truth lies under the nonsense of spiritualism," and that "the founding of a false theory on real facts should not prevent the facts themselves being allowed and studied."

Some years ago I experimented for months with a Planchette, and in other ways endeavoured to convince myself of the truth of certain physiological facts that had given rise to the theory of spiritualism. I was so circumstanced that the want of all interest in those I was associated with, amounting, in fact, to opposition, caused me reluctantly to give up all further investigation, and to cease all argument with those whose minds are so constituted that, as De Morgan says, they "infer imposture from the assumed impossibility of the phenomena asserted, and then allege imposture against the examination of the evidence."

The "Planchette" proper is, as its name implies, a little board of thin wood, heart-shaped, and mounted on three tiny brass castors that move easily in every direction. At the pointed end of the board, which is turned away from the operator, is a hole through which a pencil is fixed. The hand s placed lightly on the Planchette, that in a short time runs about making wild flourishes all over the sheet of paper placed under it, and in some hands quickly settles down into steady writing. Its own light weight can hardly be considered, and the easy castors make the frictional resistance almost nominal. I can assert with confidence that under the hand of an honest experimentor, the pressure exerts no influence in forcing the Planchette in any particular direction; on the contrary, when fairly imbued with whatever force may move it, the thing rushes about in directions quite uncontrolled and unexpected by the person whose hand is on it.

Six or seven years ago Planchettes were sold as toys by, I believe, Messrs. Cremer, in Regent-street. Previous to that they were made by a man whose name and address I have forgotten (it was mentioned in an article in *Once a Week*, about twelve years ago), who claimed that there was some occult virtue or power in the wood he used! and charged 7s. 6d. for an article any neat-handed joiner could make for about 1s.

But "T. P. B." tells us that under the hand of his friend a plate performed the same work. No castors mentioned. One would like to know more about this, as the description is insufficient. A plate of any material without castors, would offer very great frictional resistance, and would not lend itself as readily as an ordinary Planchette would to imposture. Again to quote from De Morgan, "So soon as any matter excites warm discussion and lively interest, attempts at imposition commence;" and in our investigations we should guard against this, though feeling contempt for the narrow-mindedness that refers to imposition and fraud all that cannot be otherwise explained satisfactorily, refusing to take into consideration the number of things in Heaven and earth that are still not "dreamt of in our philosophy." M. A. B.

[A number of Planchettes have been sent in response to my note. I find it is tolerably easy for a single operator to make the thing write legibly, and even neatly. Whether, with practice, one operator could so write when another person had his or her hands lightly on the instrument, I cannot say from my own knowledge. From singular stories which have reached me through persons whose word I accept unhesitatingly, I should say that, after a little practice, this can be managed. I find no tendency whatever on the Planchette's part—under my own hands only, or in company with another pair of hands—to anything like movement caused unconsciously.—R. P.]

EVOLUTION OF LIFE.

[773].—The readers of KNOWLEDGE are indebted to you for the succinct form in which the principles of the doctrine of evolution are presented to them; and without criticism of the first six, save to ask whether the *exact* "normal form of the species" has been fixed by Dr. Wilson, or the propounder of those principles (see No. 1), perhaps No. 7 presents ideas upon which "Owen, Agassiz, or Mivart" have grounds for their specific objections. Varieties are known to revert to their originals, and possibly it will be allowed that specimens of new races and species must be criticised by the laws of comparative anatomy. The probabilities of No. 8 go as far back possibly till the original ascidian is found; but are scientific facts, when exactly described, built upon probabilities? I do not pretend to criticise the intricacies of Dr. Wilson's experiments and researches, but as one of the well-meaning persons referred to, will you permit me to say that it is not the evidence of nature which is rejected, but the "if's," "may be's" settling down into "must be's," which the credulous biologist dogmatises upon.

The battle turns, in my humble opinion, upon the "Origin of Man"; and with all respect to the opinions set forth in the article in question, is not Lubbock's theory to be taken into the biological consideration of the question? Where the fact of the special and distinct act of the creation of the Adamic race is denied, the theory has proved correct that without the "light that lighteneth the world" man, left to himself, surely degenerates. Babylonians, Egyptians, Persians, Grecians, Romans, notwithstanding the advance of learning, art, and science among them, have gone. May I ask if the learning and wisdom of the Grecians prevented them from sinking into corruption and decay, speaking, of course, of their gifts as a power of self-elevation. It seems to me that it is impossible to consider man as an animal only, and here evolution, as generally presented to us, thoroughly fails. The

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highest specimens of manhood are those in whom the animal is controlled by the mind and spirit, and until Evolutionists have accounted for the birth of these two phenomena—especially the latter—we shall find that those who seek to prove their kinship with the ape will be left grovelling among the worms.

WALT. PILGRIM.

[Our correspondent fails to note that the non-existence of an exact normal form is in reality what is postulated in No. 1, and that it is not *absolutely* essential for science to "fix" an exact normal form before denying that such a form exists. Next, he falls into a common error about reversion. He should note that not varieties, but individual members of varieties, revert to their originals. The equine foal will show Zebra marks, and even the young of the human species will, occasionally, show signs of reversion to the ape type; yet the horse is distinct enough from the zebra, and the man from the ape. Where the special and distinct creation of man is denied (as inconsistent with every known fact, anatomical, physiological, psychological, embryological, and biological), the degeneration of races may yet be admitted. To me it seems unquestionably the true doctrine for every race whatsoever. The history of the race, like that of the individual man, like that also of every race of animals and of each individual animal,—indeed, like everything which exists, tells of a period of preparation, improvement, advance, full fitness for its purpose, then gradual falling-off, decay, decrepitude, and finally death, which in every case, so far as science shows, ends all, so far as that individual existence is concerned. To believe that any existing nation will be saved from the common fate seems to me as unreasonable as it would be to believe that any existing man will escape death.—R. P.]

LETTERS RECEIVED.

J. Marshall.—Story-teller.—A member of the L. S. A.—R. N.—R. Wilding.—W. H. Elliot.—H. Leney.—A Stone-breaker.—J. C. S.—Tike.—F. S. L.—A. Francis.—R. M. Neate.—C. H. Brockelbank.—A. J. C. Browne.—E. B.—J. W. Boothrayd.—A. B.—P. F. Tichnall.—S. G.—A. Bray.—A. M. L. J.—H. Atwell.—F. Chapman.—A. J. Mott.—Polarius.—C. R. T.—R. T. P.—R. Morham.—A Man in the Crowd.—Cogito.—Ahiron.—H. E. P. C.—J. Murray.—G. T. Ryves.—T. Ayers.—A. J. Mott.—R. W. Wafern.—John Hampden.

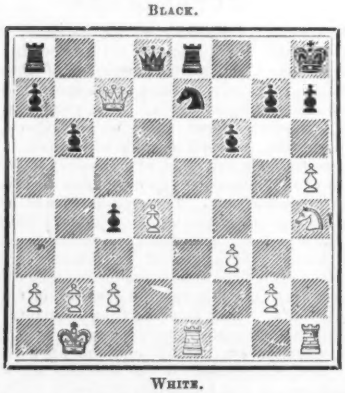
Our Chess Column.

By MEPHISTO.

END GAME FROM ACTUAL PLAY.

FROM L. P. REES.

BLACK.



WHITE.

Black's last move was Q from Q4 to Q sq. I then played R takes Kt, Q takes R, Kt to Kt6 (ch), P takes Kt. P takes P (ch), K to Kt sq. R to R8 (ch) (*a*), K takes R. Q to R2 (ch), and mates in two moves.

(*a*) If Q to R2, Black mates in two by Q to K8 (ch). No doubt Black was depending on this move.

The following short partie was played on the 16th inst. in the match of the Cambridge University Chess Club *v.* City of London Chess Club (Third Class). It is remarkable for the early defeat sustained by White, in spite of a close opening, through Black's telling style of play.

IRREGULAR OPENING.

White. — Heath, City L. C. C.	Black. H. Gwinner (Trinity), Cambridge U. C. C.	White. — Heath, City L. C. C.	Black. H. Gwinner (Trinity), Cambridge U. C. C.
1. P to KKt3	P to K3 (*a*)	10. Kt to Kt3	B to Kt3
2. P to K3	P to QR3 (*b*)	11. K to Kt2 (*f*)	P to K5!
3. P to Q4	P to Q4	12. B to B2	B to Kt5!
4. B to Q3 (*c*)	P to QB4 (*d*)	13. QKt to Q4	Kt takes Kt
5. P takes P	B takes P	14. KP takes Kt	B to B6 (ch)
6. Kt to K2 (*e*)	Kt to QB3	15. K to Kt sq	Q to Q2!
7. Castles	Kt to KB3	16. Q to K sq (*g*)	B to B2 (*h*)
8. Kt to Q2	Castles	17. B to Q sq	Q to R6
9. P to QB3	P to K4	White resigns (*i*)	

NOTES.

(*a*) In reply to most irregular moves, such as P to QKt3, P to QR3, Kt to B3, P to QB4, &c., it is safer to play P to K3 than P to K4.

(*b*) Good on general principles. Black intends developing his Queen's wing, and P to R3 prevents B to Kt5; likewise P to QB4 on a future occasion.

(*c*) Inconsequential play! The proper place for the Bishop was Kt2, or else why did White lose a move and weaken his King's side by playing P to Kt3, which ultimately enables Black to force a mate?

(*d*) Good play! Advisable in many similar positions before playing out the QKt.

(*e*) 6. Kt to KB3 would have been better, followed by Kt to QB3 and P to K4 at an early opportunity.

(*f*) Very weak! White might have defended himself by 11. P to B3, if P to K5. 12. P takes P, P takes P. 13. B to B2. Of course, White's isolated Pawn on K3 weakens the game, but he can defend it by eventually playing his Kt to Q4.

(*g*) A vain hope; White cannot save the game.

(*h*) To prevent Kt to B4.

(*i*) Mate in three, *i.e.*, 18. Kt to B4, B takes Kt. 19. B takes QB, P takes B, and Queen mates.

SOLUTION.

PROBLEM No. 79, BY W. GRIMSHAW, p. 154.

(*a*) 1. R to B2. If B takes R. 2. Kt (B6) to Q5 (ch), K to K5. 3. Q takes B mate. If Kt to B7. 2. Q to Kt sq (ch), K to B5. 3. Q to Kt 4 (ch), K to K6. 4. KKt to Q5 mate. If B to R4 (best). 2. R to QKt2!! P takes R. 3. KKt to Q5 (ch), K to K5. 4. Q to QB2 mate.

(*b*) 1. KKt to Q5 (ch), K to K5. 2. Q to R3, KB to B5, or B to R4, or R to B3. 3. R to K2 (ch), P takes R. 4. Q to Q3 mate. If 2 any other move. 3. Q takes P mate.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

J. A. Miles.—Thanks for communication.

W. F. W. R.—End position received with thanks.

Correct Solutions received.—Problem No. 78, Stettin, J. Hughes. No. 79, R. J. P. No. 80, R. J. P., M. T. H., Berrow.

Henry Planck.—In Problem 79, if 1. R to QKt2, B to Kt8 (ch), and there is no mate in four moves.

NOTICES.

The Back Numbers of KNOWLEDGE, with the exception of Nos. 1 to 13, 31, 32, and 53, are in print, and can be obtained from all booksellers and newsagents, or direct from the Publishers. Should any difficulty arise in obtaining the paper, an application to the Publishers is respectfully requested.

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